UNIVERSITI PUTRA MALAYSIA

POPULATION BIOLOGY OF BARN OWL (TYTO ALBA) AND ITS IMPACT ON RAT CONTROL IN TANJUNG KARANG RICEFIELD

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FP 2004 17

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By

MOHD. NA'IM

Thesis Submitted to the School of Graduate Studies,
Universiti Putra Malaysia,
in Fulfilment of the Requirements
for the Degree of Master of Agricultural Science

April 2004

Bismillahirrahmanirrahim

To my parents, my late father Trubus bin Karsomedjo and my mother Wagiyem binti Ahmad Karto
for their patience who brought me up

To my wife Elija Afni and
My sons Hatta Wicaksono Na'im and Afief Adiguna Na'im
for their love which nourishes my inspiration

I dedicated this work

Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfilment of the requirements for the degree of Master of Agricultural Science

POPULATION BIOLOGY OF BARN OWL (*Tyto alba*) AND ITS IMPACT ON RAT CONTROL IN TANJUNG KARANG RICEFIELD

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MOHD. NA'IM

April 2004

Chairman : Hafidzi Mohd. Nor, Ph.D.

Faculty : Agriculture

The population biology of *Tyto alba* and its impact on rat control were studied in the Tanjung Karang ricefield area. In Sawah Sempadan area, *T. alba* visited the nest boxes ranged from seven to 60 days after the nest boxes were erected. Nest occupation began 43.7 to 58 days after the nest boxes had been visited by *T. alba.* There were two breeding seasons, firstly from November to February and secondly from May to August. Rat damage on plot A (1 box/5ha), B (1 box/10ha), C (1 box/20 ha) and D (1 box/45ha) for all three paddy growth stages (tillering, booting and harvesting) varied according to nest box densities. The average damage levels for plot A, B, C and D were 0.62%, 0.79%, 1.57% and 2.18% respectively.

The nest box occupancy in wet and dry season at Sungai Burung area was 72.2%. Nevertheless, nest box occupancy could increase to 83.3% in subsequent wet season. Clutch sizes during the dry and wet season were 5.38 and 4.07 respectively. Percent hatching was 85.7% during the dry season and 79.2% during the wet

season. Fledging success for both seasons were greater than 93%. Damage levels to paddy crop during the tillering stage for both seasons were less than 2%. Damage levels during the booting and harvesting stages were also less than 2% but increased to 3.22% and 3.39% respectively during the dry season crop.

The home ranges of female *T. alba* in designated area at Sawah Sempadan were influenced by nest box densities. Female *T. alba* occupying nest box densities of 1 box per 5 ha, 1 box per 10 ha and 1 box per 20 ha have home range sizes of 5.79 ha, 14.98 ha and 18.84 ha respectively. However, male *T. alba* ranged over a larger area which might encompass neighbouring nest boxes as evidenced from the home range sizes of 34.14 ha and 39.65 ha in the 1 box/5 ha and 1 box/10 ha densities respectively.

Tyto alba fed exclusively on rat (95.15%) with occasionally on shrews (2.73%) and birds (2.12%). The ricefield rat, *Rattus argentiventer* constituted 84.04% of the identifiable rat prey species and the remainder were the wood rat, *R. tiomanicus* (10.63%) and the house rat, *R. r. diardii* (5.8%). Pellets collected in January and July in Sawah Sempadan Area respectively showed 61.1% and 69.2% of the rat prey were juveniles. Whereas, pellets collected in December and May showed a higher percentage of headless prey i.e. 76.2% and 68.4% respectively. Feeding trial in the Aviary showed that *Tyto alba* could consume up to three adult rats per night, with an average prey consumption of 174 g prey/day, where the owl

preferred medium size rats (50-80g) but when taking larger rats (>150g) it only consumed the head.

Abstrak tesis ini dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Master Sains Pertanian

BIOLOGI POPULASI BURUNG PUNGGUK (*Tyto alba*) DAN KESAN KE ATAS KAWALAN TIKUS DI KAWASAN PADI TANJUNG KARANG

Oleh

MOHD. NA'IM

April 2004

Pengerusi : Hafidzi Mohd. Nor, Ph.D.

Fakulti : Pertanian

Biologi populasi *Tyto alba* dan kesannya keatas kawalan tikus telahpun dikaji di kawasan sawah padi Tanjung Karang. Di kawasan Sawah Sempadan, burung pungguk mengunjungi kotak sarang buatan dari tujuh sehingga 60 hari setelah kotak sarang didirikan. Penghunian kotak sarang bermula 43.7 sehingga 58 hari setelah kotak sarang dikunjungi oleh burung pungguk. Terdapat dua musim membiak, pertamanya dari November hingga Februari dan keduanya dari Mei hingga Ogos. Kerosakan akibat serangan tikus di plot A (1 kotak/5ha), B (1 kotak/10ha), C (1 kotak/20 ha) dan D (1 kotak/45ha) pada ketiga peringkat tumbesaran padi (percambahan anak bilah, bunting dan penuaian) agak berbeza mengikut kepadatan kotak sarang. Purata paras kerosakan untuk plot A, B, C dan D ialah masing masing 0.62%, 0.79%, 1.57%, dan 2.18%.

Tahap penghunian kotak sarang musim hujan dan musim kering ialah 72.2%. Walau bagaimanapun, penghunian kotak sarang boleh meningkat kepada 83.3%

pada musim hujan yang berikutnya. Saiz klac pada musim kering dan hujan masing-masing ialah 5.38 dan 4.07. Peratusan penetasan ialah 85.7% pada musim kering dan 79.2% pada musim hujan. Kadar anak burung yang mencapai peringkat dewasa melebihi 93% bagi kedua-dua musim. Paras kerosakan ke atas padi adalah kurang daripada 2% pada tahap percambahan anak bilah padi di kedua-dua musim tanaman. Paras kerosakan pada tahap penghasilan bulir dan penuaian pada musim hujan juga kurang daripada 2% meningkat masing-masing kepada 3.22% dan 3.39% pada musim kering.

Banjaran kediaman burung pungguk betina dipengaruhi oleh kepadatan kotak sarang. Burung pungguk betina yang menghuni kotak sarang dengan kepadatan 1 kotak/5ha, 1 kotak/10ha dan 1 kotak/20ha masing-masing mempunyai banjaran kediaman 5.79 ha, 14,98 ha dan 18.84 ha. Walau bagaimanapun, burung pungguk jantan mempunyai banjaran kediaman yang lebih luas yang meliputi kotak sarang berdekatan seperti yang terbukti seluas 34.14 ha dan 39.65 ha masing-masing pada kepadatan 1 kotak/5ha dan 1 kotak/10ha.

Tikus adalah makanan utama burung pungguk (95.15%) dan kadang kala cencurut (2.73%) dan burung (2.12%). Tikus sawah padi, *Rattus argentiventer* mewakili 84.04% daripada spesies tikus yang boleh dikenal pasti dan selebihnya adalah tikus belukar, *R. tiomanicus* (10.63%) dan tikus rumah, *R. r. diardii* (5.8%). Pelet yang dikumpulkan pada bulan Januari dan Julai di kawasan Sawah Sempadan masing-masing memperlihatkan 61.1% dan 69.2% daripada mangsa adalah juvana.

Manakala pelet yang dikumpulkan pada bulan Disember dan Mei masing-masing menunjukkan peratusan sisa tikus tanpa kepala yang lebih tinggi iaitu 76.2% dan 68.4%. Kajian pemakanan di aviari menunjukkan bahawa *T. alba* boleh memakan sehingga 3 ekor tikus dewasa setiap malam, dengan purata pemakanan harian sebanyak 174g mangsa sehari. Burung pungguk menggemari tikus yang bersaiz sederhana (50-80g) tetapi apabila mengambil tikus yang lebih besar (>150 g) ia memakan hanya bahagian kepala.

ACKNOWLEDGEMENTS

I would like to thank Universiti Putra Malaysia for funding my study through IRPA research grant (01-02-04-0430-51490).

I would also like to express my gratitude and sincere appreciation to Chairman of supervisory committee Dr. Hafidzi Mohd. Nor, Department of Plant Protection, Faculty of Agriculture, University Putra Malaysia for his understanding, dedicated efforts, valuable advice and guidance throughout this study, as well as critically reading this manuscript.

My deep appreciation also goes to members of supervisory committee: Prof. Dr. Zubaid Akbar, School of Environmental and Natural Resources Sciences, Universiti Kebangsaan Malaysia and Assoc. Prof. Dr. Harun Budin, Faculty Science and Environmental Studies, Universiti Putra Malaysia, for their invaluable advice, constant encouragement and guidance throughout this research.

I would also like to express my acknowledgement to Mr. Kamaruddin Abdul Aziz, head of the Plant Protection Unit of Sungai Burung for allowing this study to be carried out in the ricefields of Tanjung Karang. Also thanks to Mr.Chong and Mr Mad Maidin for their valued assistance in the field.

All staff of Toxicology Laboratory, UPM is thanked for their help in providing assistance for the facilities for the research.

Special thanks to my host family in Sawah Sempadan, Mr.Jamaluddin and his wife Mrs. Ummi Kalsom and their son Mr. Roslan and his wife Mrs. Zubaidah for their hospitality during my study.

I am deeply grateful to my parents, my brothers and my sisters and my spouse, Elija Afni and my son Hatta Wicaksono, for their unwavering love, patience and support during the study.

I certify that an Examination Committee met on April 10, 2004 to conduct the final examination of Mohd. Na'im on his Master of Agricultural Science thesis entitled "Population Biology of Barn Owl (*Tyto alba*) and its Impact on Rat Control in Tanjung Karang Ricefield" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfilment of the requirement for the degree of Master Agricultural of Science. The members of the Supervisory Committee are as follows:

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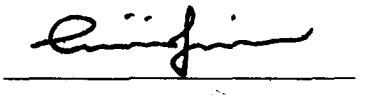

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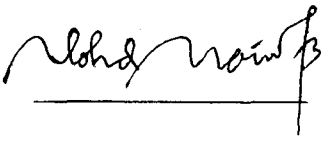
DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



MOHD.NA'IM

Date : April 9, 2004

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CHAPTER 1

INTRODUCTION

Rice is the most important staple crop in Malaysia. In 1999, 692,000 ha of land was cultivated under rice in Peninsular Malaysia (Anonymous, 2002). Rice is exposed to pests, diseases and weeds, resulting in lower yields. One of the most important rice pests in Malaysia is rats, particularly *Rattus* spp. They attack all stages of the rice crop from seedling to harvesting (Shamsiah and Goh, 1991; Buckle, 1994).

Rat damage to rice in Peninsular Malaysia was first reported in 1908 (Galagher, 1908). Chasen (1940) listed 26 species of rats in the Peninsular Malaysia of which 18 belonged to the genus *Rattus*. Of these, the rice field rat, *Rattus argentiventer* is the most serious pest in ricefield (Harrison, 1957; Wood, 1971), occurring throughout most of South East Asia (South Vietnam, Thailand, and Peninsular Malaysia), the greater Sunda Islands (Lombok, Sumbawa, Komodo, Rintja, Flores, Sumba, and Timor), Celebes and Philippines (Mindoro and Mindanao) and New Guinea (Musser, 1973; Leung *et al.,* 1999).

A number of studies carried out in Malaysia in recent decades, showed that rat damage varies from 5% (Grist and Lever, 1969; Lam and Abdullah, 1975; Mochizuki, 1975; Grantz 1990) to 18 % (Hafidzi *et al.*, 1999).

Different methods have been employed to deal with rat infestation in ricefields in Malaysia. These include good cultural practices, mechanical control like the implementation of TBS (Trap Barrier System) (Lam *et al.*, 1987), the application of rodenticides (Buckle, 1994), and the reliance on natural enemies as biological control agents (Wood, 1976; Lam, 1982; Lim, 1999). Although chemical control, primarily by the use of rodenticides has been widely practiced, it is by no means the single most effective method of control.

In recent years the idea of using natural enemies to deal with rats in the form of predators and parasites is becoming a more attractive option. Some of the predators commonly found in the ricefield in Malaysia are the common Malaysian racer *Elaphe flavolineata*, the cobra *Naja naja*, the python *Python reticulatus*, the water lizard *Varanus salvator,* the barn owl *Tyto alba*, black shoulder kite *Elanus caeruleus*, and Brahminy kite *Haliastur indus*. Among the local parasites identified are the nematodes *Angiostrongylus cantonensis* and *Hepatojuarakus malayae* (Wood, 1976; Lam, 1982; Lim, 1999)

Tyto alba has been used as a biological agent to control rats in crops and plantations in Malaysia namely oil palm (Duckett, 1976; Lenton, 1980; Smal, 1988; Chia and Lim, 1995), cocoa (Lee and Ho, 1999) and ricefields (Shamsiah and Goh, 1991; Hafidzi *et al.*, 1999). Essentially the propagation of *T. alba* entails the provision of suitable nest sites, and also hunting perches where necessary (Smal, 1988). One of the factor that limits the spread of *T. alba* is the lack of suitable sites for nesting (Lenton, 1984).

In order to increase *T. alba* population for use in biological control, Debach and Rosen (1991) has identified a number of biotic and abiotic parameters. These include weather and other physical factors such as quality and quantity of food, interspecific competition, intraspecific competition, territorial requirements, emmigration and immigration. As such it, is important to understand the basic ecology of *T. alba* in ricefield in Malaysia, thereby improving management practices and enhancing the effectiveness of *T. alba* in controlling rats.

In the Tanjung Karang ricefields area, Selangor, numbers of *T. alba* grow rapidly and abundant since a research program was initiated by Department of Agriculture in 1989. However, very little studies about the ecology of *T. alba* in ricefields area have been made. Therefore, this study was initiate to reveal the role of ecological factors on *T. alba* in the Tanjung Karang ricefields area.

The research objectives of this study are as follows:

1. To investigate the influence of nest box density on *T. alba* propagation.
2. To investigate the influence of climate, namely wet and dry season on propagation and feeding behaviour of *T. alba*.
3. To investigate the relationship between nest box densities and territorial behaviour of *T. alba*
4. To determine prey preference of *T. alba*.

CHAPTER 2

LITERATURE REVIEW

2.1 Pests of Rice

A published list by Grist and Lever (1969) records over 800 insect pests of rice, of which less than 200 are considered important. Other important pests are birds, crabs, snail, and rats (Grist, 1986). Among these, rats are the most destructive. They gnaw the stems, eat the standing grain and ravage the rice stores. A study done by Lam (1990) shows that rats are a major pest that can cause severe damage, whereby it can reach 35% in the direct seeding system where no control methods have been implemented. However, Wood (1971) found that when effective control of rats infesting ricefields was attained, yield increases and often reaching 100% yield were obtained.

2.2 Rats as Pests of Rice

Rats probably arrived in Southeast Asia in the late Miocene. They are primarily omnivorous, but largely vegetarian, feeding mainly on plant material (MacDonald and Fenn, 1994). They can thrive in most situations, whether natural or modified by man, both agricultural as well as urban. Besides, being important pests of several crops, rats also can spread diseases such as scrub, thypus, leptospirosis, plague, hantavirus and arenavirus to human (Mills, 1999). In Malaysia, leptospirosis is

particularly common among oil palm estate workers who are exposed to *R. tiomanicus* (Smith *et al.*, 1961). Infection rates in ricefield workers was 12% and the reservoir rat species were mostly *R. argentiventer*, which excretes the leptospires at a high (Tan, 1973).

Rice is susceptible to damage by rats at all stages of its growth. Rice seeds and emerging seedlings are readily taken, both in nursery beds and when directly sown in the field. As the young rice plant grows, the tillers develop soft stem bases, which are particularly attractive to rats. Stem damage at this active tillering stage sometimes appear cleanly cut when fresh, but later all that may remain is an accumulation of decaying fibrous tissue. Similarly, damage at the booting stage is often ragged due to the rats' attempt to gain access to the unsheathed, developing rice panicles at the bases of tillers (Buckle, 1994). In the booting stage, rats cut the tillers at a height of 1-2 cm (Murakami *et al.*, 1990). After the heading stage, rice stem has a tubular cross-section. These are cut by rats to bring down the grain bearing panicle, and rats cut 5-10 cm under the panicle from heading stage (Murakami *et al.*, 1990; Buckle, 1994). The cutting behavior of rice rats showed that rats only cut the tillers of 6 to 12 weeks old rice, and cut the tillers and panicles of 14 weeks old rice and only cut the panicle of 16 weeks old rice (West and Fall, 1977).

The distribution of rat damage in the ricefields is highly variable. When damage is light, cut tillers may be widely distributed in fields but visually undetectable by cursory examination. When damage is moderate, it is often seen as patches of heavily damaged plants surrounded by areas of relatively light damage. However when damage is heavy, the centre of the field is almost totally destroyed, while the borders sustain little or no damage (Buckle, 1994).

2.3 Ricefield rat *Rattus argentiventer*

Harrison (1957) and Wood (1971) identified *R. argentiventer* as the main rat species attacking rice. Adult *R. argentiventer* has a body length 150 to 190mm. The tail is 95 to 115% of the head and body length, hind foot 32-35 mm, ear 19-23 mm, and weighs 85-180g. The dorsal fur is rough and olive brown, with yellow and black hairs intermixed, but without prominent spines. The venter is silvery grey, often with a darker longitudinal streak in the mid-line. The tail is uniformly dark, and has three pairs of pectoral (on the chest) and inguinal (on the groin) mammae. The proportion of the anterior palatine foramine which are usually longer than the cheek teeth, and extend backward so that their posterior margins fall just posterior to a line joining the anterior faces of the first cheek teeth. The gestation period for females averages 21.4 days. Litter size is 5-7. The rat becomes sexually mature at about 90 days for males and 49 days for females. The sex ratio of *R. argentiventer* is 1.09:1 in the favour of males. Mean life-span is 6.2 months (Medway, 1978; Lam, 1983).